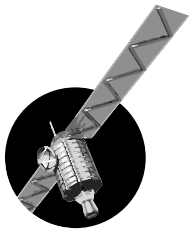

Aerospace Integration, Not Separation

MAJ GEN (SEL) JOHN L. BARRY, USAF
COL DARRELL L. HERRIGES, USAF

PRESIDENT DWIGHT D. Eisenhower once said, "Our real problem is not our strength today; it is rather the vital necessity of action today to ensure our strength tomorrow." His words conveyed a simple truth recognized by all successful leaders. An organization must constantly renew itself. It can never stand still—never settle for the status quo. Forward movement is key to the health of every institution.

Continuous revitalization has long been a hallmark of the United States Air Force (USAF). Our service has renewed itself over the years with new technologies, new operational concepts, and new leadership. This trait, although fatiguing at times, is recognized by all as critical to our long-term strength.

One of the latest steps in this process is called "aerospace integration." It embodies our organizational commitment to change the way we think about air and space power. In essence, *we are committed to becoming an aerospace force, operating in a seamless medium unconstrained by arbitrary divisions of the vertical dimension*. This is no easy goal. It will prove difficult to obtain. However, it is a necessary step if we are to progress as a leading-edge institution.

Unfortunately, this initiative is opposed by some. Reasonable people argue that operations in the air and in space differ so fundamentally as to require separate organizations. This argument has even gained a following among some influential members of the defense community. But the argument is unsound. It is based on physics, not military art. By their nature, however, military operations in the aerospace continuum require a mix of air and space systems. It would be unsound to divide the development of one area from the other.

Examples of Aerospace Operations

For example, imagine a future conflict with each side contesting the other's space operations. One of the first targets in any space supremacy campaign would undoubtedly be the enemy's ground-control stations. These stations uplink commands to satellites and download data. They are critical nodes in any space architecture. The small number of these critical nodes makes them particularly attractive targets. Disable these ground stations and the utility of subordinate satellites drastically decreases.

If you were designing future air and space forces for this mission, what would you develop? What air and space tools would you provide future commanders to destroy enemy ground-control stations? Deorbiting munitions? Penetrating bombers with precision munitions? Cruise missiles? Hypersonic missiles? Information warfare? Conventionally armed intercontinental ballistic missiles (ICBM)? Each of these attack options could work. However, a total reliance on any one of them would be a mistake. An enemy could focus defenses to defeat a single type of attack. If the single type of attack failed, there would be no "plan B."

A better approach would mesh air and space capabilities into an integrated aerospace attack. The task would be to destroy an enemy's satellite ground-control capabilities. The means would be a multiaxis attack by aerospace forces, compelling the enemy to

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
2000		**00-00-2000 to 00-00-2000**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Aerospace Integration, Not Separation	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Air and Space Power Journal,155 N. Twining St,Maxwell AFB,AL,36112-6026**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**Same as Report (SAR)**	**6**	

defend its ground stations against simultaneous, multifaceted attacks from every axis in the vertical dimension.

Another example could involve an enemy antisatellite (ASAT) weapon. The overall campaign objective would be to negate the threat posed by an enemy ASAT to a US satellite or constellation. The means could vary. The friendly satellite could maneuver. It could have internal defenses. An airborne laser could intercept the ASAT in boost phase. A missile or bomber could destroy the ASAT's launchpad. If the ASAT is air launched, fighters could attack the launch aircraft. Alternatively, should the ASAT hit the satellite, the effect could be negated either through rapid replacement of the satellite or by transferring the satellite's function to another satellite or to a high-altitude unmanned aerial vehicle (UAV). As in the previous example, the best solution would fuse a range of aerospace capabilities, as opposed to fixating on any single solution set.

These examples treat only one aspect of a strike's calculus (the actual attack). The same logic applies to every aspect of a strike, whether the target is air or space related. To illustrate this concept, take each individual step in an aerospace strike: find, fix, track, target, engage, and assess (known in the USAF by its acronym F^2T^2EA). Any strike of mobile targets must find the target, fix its exact location, track any movement, orchestrate an attack package, engage the target, and then assess the results. As with the two attack examples in the previous paragraph, each of these individual steps could be conducted by a mix of air and space platforms:

- Signal-intercept platforms on-orbit or airborne could identify the type of target and its general location. (Find)
- A high-altitude UAV with a laser designator, using the Global Positioning System (GPS) for precision, could generate the exact coordinates. (Fix)
- A joint surveillance, target attack radar system aircraft; Global Hawk UAV; or a Discoverer-type satellite could track any movement. (Track)
- An integrated command and control (C^2) system could task a mix of space and air systems to expedite time-phased attack packages. (Target)
- As stated above, a mix of air and space systems could conduct the actual attack(s). (Engage)
- Satellites and aircraft (manned and unmanned) could determine the extent of the damage. (Assess)

Iterative and Changing Technologies

A subtle point, often missed by those pushing space separatism, is that technologies underwriting a multifaceted aerospace approach are rapidly advancing. Stealth, space launch, precision, and bandwidth are only some of the key aerospace technologies whose potential remains optimistic but opaque. Complicating the challenge is the fact that these technologies are not only advancing, they are doing so at widely different rates. They are not moving forward in parallel; rather, they each leap ahead at unpredictable times and at unpredictable rates. Because these technologies (1) enable each aspect of a future campaign and (2) interact with each other, professionals must constantly adjust the time phasing of their development and deployment.

Designers of tomorrow's aerospace force must mix evolving technologies. They must keep one eye on marginal advantage and the other on time phasing. Stealth, propulsion, sensors, bandwidth, precision munitions, materials, range, C^2, interoperability, electronic warfare, information warfare, directed energy, infrared spectrum, and simulation are but a few of the changing technologies incorporated in practically every aerospace system. With each technology advancing at a different rate, their integration is an immense task. This integration is difficult when managed by

a single service. It would be even more difficult if subjected to the "roles-and-missions" frictions inherent when separate military services work the same task.

Understandably, no one mix of systems will ever satisfy advocates of each individual component. Whenever we prioritize, someone inevitably gets the lowest priority—and advocates for that system predictably complain. Nonetheless, history shows that a singular leader dedicated to the success of the overall operation can best translate multiple advancing technologies into an overall system of systems. Because air and space systems work together for mutual benefit and because air and space technologies are rapidly advancing, integration of aerospace priorities is critical to the future benefit of both.

Cost-to-Orbit Challenge

One of the impediments to progress in space operations is the high cost to achieve orbit. It's expensive to put an object of any size and capability in space. A good rule of thumb for cost to orbit is $10,000 per pound, a rule that has held constant for 20 years.[1] This means that placing five one-thousand-pound weapons in space, for example, would cost somewhere around $50 million. Those would be five expensive bullets.

This is one of the reasons weaponization of space has progressed slowly. Space platforms have centered on surveillance and communications, not weapons. They relay communications, observe surface events, and enhance navigation. There are no space-superiority weapons in space. The only weapons to contest space superiority are atmospheric (e.g., lasers to disrupt satellites, bombers to attack satellite ground-control stations, and information attacks on datalinks).

We expect this situation to change, especially as costs to orbit decrease. Space weapons will become more cost-efficient versus atmospheric systems over time. While the evolved expendable launch vehicle will improve the current situation, the most promising technology to change the paradigm is hypersonics. A single-stage-to-orbit launch vehicle using hypersonic technology is the goal of the National Aeronautics and Space Administration's reusable launch vehicle project (although an operational variant is still over a decade away).

This program is a follow-on of the national aerospace plane, a project cancelled in 1994. The "aerospace" nature of this technology conveys its dual capability. It will operate in both the air and space. This means the technology with the greatest promise for increasing operations in space is aerospace by its nature. How ironic it would be to divide air and space institutionally at the same time technology is fusing the two media!

Cold War

Air and space integration is nothing new to the USAF. During the cold war, air and space operations overlapped with a mix of strategic reconnaissance aircraft (e.g., SR-71, U-2) and satellites combined to surveil the Soviet Union. In addition, a mix of satellites (e.g., Defense Support Program [DSP]) and ground radars (e.g., ballistic missile early warning system and the PAVE PAWS type of phased array radars) combined to give strategic warning, and a mix of ICBMs, bombers, and air defense fighters stood continuous alert. In other words, this was a situation in which space and air systems combined to accomplish the USAF's strategic deterrence mission.

During this era, space systems were funded due to their critical support to nuclear deterrence. The single integrated operational plan (SIOP), a series of strategic nuclear war plans, demanded integrated air and space operations. The alert status of B-52 bombers, for example, was based on the warning time afforded by DSP satellites. Targets and yields depended on information gained by overhead imagery. Strategy, force structure, and operational concepts were iterative between the space and air communities. Gen Thomas White, former USAF chief of staff, could state in 1957 without qualification, "There is no division . . . between air and space. Air and

space are an indivisible field of operations."[2] Hence, during the cold war, there was little distance between the USAF's nuclear deterrence forces and its space operations.

This same close relationship also existed between the USAF and the National Reconnaissance Office (NRO). It was modeled on the successful USAF–Central Intelligence Agency partnership that prosecuted the strategic airborne reconnaissance mission (e.g., the U-2). In fact, the undersecretary of the Air Force served as the director of the NRO. It's safe to describe the two organizations as "joined-at-the-hip," as they formed a strategic partnership to accomplish the overhead reconnaissance mission.

After the Cold War

The end of the cold war and the explosion of the Information Age established additional links between the USAF's space and air forces. These links were apparent to all in the Persian Gulf War, where DSP satellites, procured to detect Soviet ICBM launches, were used to detect Iraqi Scud launches. Their launch cues were forwarded to both terminal defenses (such as the Army's Patriot batteries) and retaliatory strikers (the so-called Scud hunters). Reconnaissance satellites, also procured with the cold war in mind, were focused on this regional, conventional threat. Thus, the critical contributions of space systems in Operation Desert Storm prompted some to call it the first space war.

Today, all military communities use space assets on a daily basis. Everyone from peacekeepers to supply officers routinely depends on space support to perform daily tasks. All consider space infrastructure critical to operations.

Given this critical dependence, the search for a new organizational structure for space is understandable. The cold war, pre–Information Age construct is clearly obsolete. One of the more popular alternative structures would concentrate all space assets in a dedicated organization. Because space support is a limited national asset, the argument goes, a single manager could best develop and distribute space support to users, irrespective of service tie. For some, this is the preferred model for organizing military space capabilities.

The emphasis on space support, however, is a curious argument. It organizes space assets around its support function. If space is simply the home for a support infrastructure, that approach may be valid. However, the better argument is that the value of space goes far beyond its support to other military operations. The secretary of defense made the department's view clear on this point: "Spacepower has become as important to the Nation as land, sea and air power."[3] The Air Force believes space has evolved into a national strategic center of gravity. It fully subscribes to the national security strategy's assertion that "unimpeded access to and use of space is essential for protecting US national security."[4] In that respect, it is important to heed the cautions of the commander of US Space Command that our nation's space systems are "too tempting a target for terrorism or adversarial military operations."[5] As the Hart-Rudman Commission recently stated, "Space will become a critical and competitive military environment. . . . Weapons will likely be put in space."[6] Simply put, space is an economic and military center of gravity at the strategic level of war. Our space architecture needs positive protection. With space systems critically important to the nation and the potential for space to evolve into a contested medium, the most prudent military approach would organize military operations in space around war fighting, not just support.

Because any fight for space control would require a mixture of air and space operations, the optimal organizational structure should encompass both. That organizational structure, of course, already exists. The USAF, which conducts war in the vertical dimension, transcends any arbitrary boundary between air and space. By encompassing both media, the USAF is positioned to exploit emerging synergies. It is the USAF that can best make the most correct (though still painful) force

structure trade-offs with the most important factor—war fighting—in mind.

One of Many Integrations

Aerospace integration can be seen as part of a pattern. Since the early 1990s, the USAF has undergone a series of integration actions. So-called strategic and tactical bombers were joined into Air Combat Command. The education and training establishments were integrated into Air Education and Training Command. Aerial refuelers, previously tethered to the Strategic Air Command and the SIOP, were combined with airlifters into the new Air Mobility Command. The people who develop new systems and those who maintain and modernize those systems were merged into Air Force Materiel Command. These and many other mergers cut across stovepipes no longer relevant to the Information Age and the post-cold-war world.

Some argue that one of the last stovepipes separates the space community from the rest of the USAF. Along with the fissure between active and reserve forces, the gulf between those who fly satellites and those who fly bombers, transports, and fighters has been identified as needing a fix.

The goal is simple: an eventual full-spectrum aerospace force. As the secretary of the Air Force recently said, "Most importantly, we must integrate all of our stove-piped forces into a single *aerospace* force that draws on the strengths of all of our skills and all of our forces, whether those forces operate missiles from below the ground, fly aircraft above the ground, or work on the ground to operate and maintain our satellites and UAVs" (emphasis added).[7]

This challenge is not unique to the USAF. Each of the services must integrate space with its other operations because each of the services has immense equities in space. However, the USAF may be distinctive in one respect. It not only uses space to enhance its air operations, but is also dedicated to migrating core roles and missions into space when it makes sense. This commitment is core to our singular vision: aerospace integration is one of two key elements of our Air Force Vision (the other being the Expeditionary Aerospace Force).

In concrete terms, there are positive steps in the integration process, such as the Aerospace Integration Center at Nellis AFB, Nevada. In addition, the space quotient is now more emphasized in our professional military education to include the new Aerospace Basic Course and the development of a new continuum of education. Also under development is an Aerospace Integration Plan. By the spring of 2000, this plan will specify tasks to further the integration of air and space capabilities within the Air Force. As with previous integration efforts, the USAF is dedicated to the success of this undertaking.

Organizational Identities Will Remain

In the best of worlds, aerospace integration will have its limits. There will remain marked differences between space operations and operations in other USAF specialties. However, they will not become one interchangeable whole, each blending perfectly with the other. Such an integration is neither possible nor desirable.

In today's USAF, there are many communities. Fighters, bombers, and airlifters each form a separate community, as do logisticians, security police, and so forth. Cross-flow between them is modest. A fighter pilot, for example, is seldom selected to command a bomber squadron. An airlifter and a security policeman may go to school together or serve on a staff together, but they will likely return to their separate communities for operational assignments.

Within the operational communities as well, there are many subspecialties, similarly rigid in their assignments. Very few C-130 pilots will ever fly the C-5, and very few F-15 pilots will ever fly an F-16. They will train and fight together, and they will influence each other—but each will retain an operational identity.

The space community is no different. Space has its own subcommunities. There is a difference between satellite flyers (e.g., operators of

GPS, DSP) and satellite watchers (space surveillance). The missileers constitute another category. Those who concentrate on acquisition comprise still another community.

This is not to argue that subcommunities are inherently good. We only need acknowledge their ingrained presence. If the litmus test for aerospace integration is completely interchangeable air and space communities, such a goal is probably unrealistic. It would go beyond any integration achieved within existing USAF communities. Yet, having professionals with an aerospace mind-set (and associated skill-set) as opposed to a narrow community focus is a very achievable and desirable situation. It is the right path for the USAF to follow in the months and years ahead.

Summary

"The English writer C. S. Lewis (1898–1963) once contended that 'the first qualification for judging any [thing] . . . from a corkscrew to a cathedral is to know what it is—what it was intended to do and how it was meant to be used.'"[9] This is a useful reminder for USAF planners. As we renew our service for the changing political and technological environment, it is important to emphasize *effect* ("what it was intended to do") as opposed to organizing around *means*, such as a specific technology. This is true whether the technology is a corkscrew or a cathedral, an aircraft or a satellite.

Those who would split air and space today fail to keep in mind the integrated nature of air and space operations. Each depends on the other. Space depends on air for weapons. This dependence will continue as long as costs to achieve orbit remain exorbitant. It will continue even longer if hypersonics proves to be the ultimate cost-cutter to achieve orbit (because it is inherently aerospace). Air operators, on the other hand, would be at untenable risk without the intelligence, communication, and positioning provided by space. This dependence was true during the cold war. It will continue for the foreseeable future. This is the reason we are continuing to pursue aerospace integration. Despite the different physics of their means, air and space forces maximize their potential when they combine into a unified aerospace effect.

Aerospace integration is not a new concept. It was the norm during the cold war. Satellites, bombers, and missiles combined to produce nuclear deterrence. Aerospace integration can also be understood as part of a series of internal USAF integrations. Bombers, educators, and scientists have all been affected by previous mergers. The result of these mergers is not that all parts are interchangeable and everyone looks the same. Rather, it is that all parts retain their identities while working together for a common purpose. This is the goal of aerospace integration: enhance the USAF's overall war-fighting performance across each aerospace capability. While retaining their separate credentials and expertise, those who fly and develop satellites, bombers, and transports will better integrate their efforts. Because air and space systems work together and because air and space technologies are rapidly advancing, integration of aerospace priorities is fundamental to improving the war-fighting capabilities of the joint team and the nation. Now is the time for continued aerospace integration, not separation! □

Notes

1. "Depending on the requirements and the launch vehicle used, costs vary between $10,000 and $30,000 per kilogram of payload." James E. Oberg, *Space Power Theory* (Washington, D.C.: Government Printing Office, 1999), 91.
2. Lt Gen Roger DeKok, *Beyond the Horizon*: *Realizing America's Aerospace Force*, white paper (Washington, D.C.: Department of the Air Force, November 1999).
3. Secretary of Defense William Cohen, *Annual Report to the President and the Congress* (Washington, D.C.: Government Printing Office, 1998), 7-1.
4. The White House, *A National Security Strategy for a New Century* (Washington, D.C.: Government Printing Office, 1998), 25.
5. Gen Richard B. Myers, commander, US Space Command, remarks to the US Space Foundation, Colorado Springs, Colo., 7 April 1999.
6. "Phase I Report on the Emerging Global Security Environment for the First Quarter of the 21st Century," *The United States Commission on National Security/21st Century*, 15 September 1999, 6.
7. Secretary of the Air Force F. Whitten Peters, keynote address, Air Force Association luncheon, 15 September 1999.
8. DeKok.
9. Excerpted from Dr. James H. Toner, "Gallant Atavism: The Military Ethic in an Age of Nihilism," *Airpower Journal* 10, no. 2 (Summer 1996): 14.